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Project Summary

Demonstration, Operation, and Testing of a Fabric Filter on an Industrial Boiler for an Extended Period of Time

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A number of fabric filters were evaluated in baghouses controlling particulate emissions from industrial coal-fired stoker boilers. Various techniques were employed to achieve higher gas-to-cloth (G/C) ratios and longer bag life. It was found that off-line, high energy, pulse jet cleaning was necessary for long term pressure drop stability at G/C ratios greater than 5/1. Cleaning energy dramatically affected filter performance, but cleaning frequency had only a minor effect. A felted fabric combination of Teflon and glass exhibited excellent performance, life, and stability.

This Project Summary was developed by EPA's Air and Energy Engineering Research Laboratory, Research Triangle Park, NC, to announce key findings of the research project that is fully documented in a separate report of the same title (see Project Report ordering information at back).

Introduction

Previous pilot and full-scale programs had shown that fabric filters could be successfully used in a baghouse controlling the particulate emissions from coal-fired industrial boilers, but that gas-to-cloth (G/C) ratios and bag life needed improvement. A program for this purpose was instituted in March 1981, at Kerr Finishing Co., Travelers Rest, SC, where two tandem baghouses were in operation and controlling the particulate from industrial coal-fired boilers. These boilers produced steam for a textile finishing plant where load requirements fluctuated often and rapidly, and harsh cycling conditions of start-up and shutdown produced frequent dewpoint excursions in the baghouses.

One of the baghouses was a pulse jet dust collector with on- and off-line cleaning capability. The other baghouse had high volume, low pressure (10 in. w.g.; 2.49 kPa), reverse-flush cleaning which provided a cleaning energy less than a pulse-jet but higher than conventional reverse-air cleaned baghouses.

This report summarizes the results of this program, which was terminated in November 1982.

Baghouse Details

Both baghouses contained 648 bags, 5 in. (12.7 cm) in diameter and 104 in. (264.2 cm) long, providing a total filtration area of 6800 ft^2 (631.7 m^2). Each house was divided into six cells.

Normal operation of the pulse jet baghouse was to take a cell off-line during pulse cleaning. All fabric in this house was a form of Teflon felt, with each cell having bags of the same material. Felts of varying weight and construction were evaluated.

The second house was cleaned by air plenum pulse, rather than pulse jet. Four fabric sets were evaluated in this house: three woven glass sets with varying finishes, and one Nomex felt set with an acid resistant finish.

Parameters Studied

Parameters studied as having an effect on the gas-to-cloth ratio were: (1) cleaning energy—pulse jet vs. re-

verse air vs. combinations; (2) cleaning mode—on vs. off-line; (3) cleaning frequency; and (4) fabric type and style.

Operational Stability

The criterion for stable operation of a baghouse cell was the "drag," defined as the average tubesheet differential pressure (ΔP) during a filtering cycle, divided by the G/C of the cell. When no consistent upward movement in drag was observed over a 2 to 3 day period, a cell was considered to have short-term stability.

ΔP across the cells was equalized, and the cell flows were monitored. G/C ratios, which fluctuated with steam load, typically varied from 5 to 8.

EmissionsTesting

Method 5 testing for outlet particulate concentrations vs. evaluation variable was not done because of budget constraints. Both baghouses passed standard state compliance testing.

Fabric Evaluation

Fabric properties were evaluated by removing bags from the baghouses and testing them in the laboratory for tensile strength, Mullen burst strength, MIT flexes, loss on ignition, and permeability. Visual and microscopic inspections were also performed.

Fabric permeabilities determined in the laboratory as part of the fabric evaluation program were compared on a relative basis, since removal of a bag from the baghouse must alter the cake properties on the fabric.

Bag Conditioning

Bags were conditioned for 4 weeks at G/C ratios of 1.5 to 2.5 with flow, temperature, and cell ΔP carefully monitored. Bags were also visually inspected periodically.

Fabric Properties vs. Time

Part of the program involved fabric property tests performed on bags from the plenum pulse baghouse after 1 hour, 24 hours, 1 week, 1 month, 3 months, 5 months, and 7 months of service. The material tested was woven fiberglass with acid resistant Teflon B and an experimental Teflon finish, and Nomex felt with an acid resistant finish. These tests provided the first documentation of how rapidly strength characteristics change with time.

Conclusions

High G/C Study

Pulse jet cleaning of felted fabric was necessary for long term pressure drop stability at G/C ratios higher than 4/1. There were indications that woven fabrics could not operate stably above 4/1 on a long term basis.

Off-line pulse jet cleaning was required for stable operation at G/C ratios above 4-5/1.

A new Teflon felt consisting of Teflon and glass fibers performed very well throughout the test period at G/C ratios of 7-9 and with stable pressure drops. This fabric exhibited the potential of operating at G/C ratios 50% or more above those in practice today. Additional long term studies are warranted.

Effect of Cleaning on Drag

Fabric drag was found to be a strong function of cleaning energy. An increase of 50% in energy decreased the drag by 30%. However, the effect of cleaning frequency, which varied from 6 to 20 minutes, was slight.

Fabric Life

Woven glass bags with either 7% Teflon B or acid resistant finishes survived about 2 years in the low cleaning energy baghouse. These bags were not tested in the pulse jet house.

Nomex bags failed within 6 months of normal operation because of the high sulfur trioxide.

Teflon felt proved very durable. A cell of original bags was still functioning after 5 years, and no major failure rates occurred on any of the other Teflon constructions except for an asymmetrical felt construction.

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The complete report, entitled "Demonstration, Operation, and Testing of a Fabric Filter on an Industrial Boiler for an Extended Period of Time," (Order No. PB 87-111 134/AS; Cost: $13.95, subject to change) will be available only from:

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